

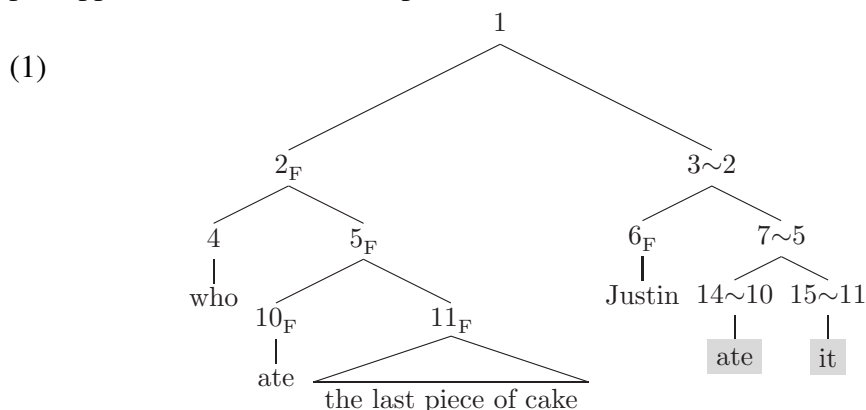
Representing Focus Scoping over New*

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1. Syntax of focus

Example (1) illustrates the locus/scope/antecedent syntax for focus. Focused phrases are marked with a feature F (Jackendoff 1972). The operator $\sim k$ marks the scope of F (Rooth 1992), and index k marks an antecedent in the syntax or discourse representation with respect to which the scope of the focus is partially redundant. Redundancy is characterized semantically either in terms of alternatives (Rooth 1991) or a generalized notion of entailment (Schwarzschild 1999). In the first option, the indexing $3 \sim 2$ is licensed because the alternative set contributed by the question is consistent with the focus-determined alternative set associated with the answer. Specifically, every proposition of the form ‘y ate the last piece of cake’, where y is a person, is a proposition of the form ‘y ate the last piece of cake’, where y is an entity. In the entailment option, it is licensed because the proposition ‘somebody ate the last piece of cake’ entails the proposition ‘some entity ate the last piece of cake’. Technically, the constraints introduced by the redundancy operator are presuppositions about the interpretation of the antecedent.



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Schwarzschild (1999) argued that anaphoric destressing and the opposition given-new are part of the focus/redundancy system. In the $F/\sim k$ syntax, anaphoric destressing is represented with a structure $\phi \sim k$, where the phrase ϕ does not embed a free F . In (1), the VP node labeled 7 and its sub-constituents have redundancy operators that are co-indexed with antecedents that have identical interpretations. Identity of interpretation is sufficient to license co-indexing. For instance, 15~11 is licensed semantically because the last piece of cake is identical to the last piece of cake. Such completely redundant phrases surface with reduced prosody, as indicated here with a gray background.

The verb labeled 14~10 in (1) is marked as redundant, with the verb labeled 10_F as antecedent. Notice that the antecedent is F -marked, rather than being marked for redundancy with $\sim k$. The same holds for the dominating VP labeled 5_F. It is stipulated that any node is marked either with F or $\sim k$, so that F can “protect” a node from the requirement to have an antecedent. In this way F can be the syntactic reflex of novelty in context.

2. Realization of focus over new

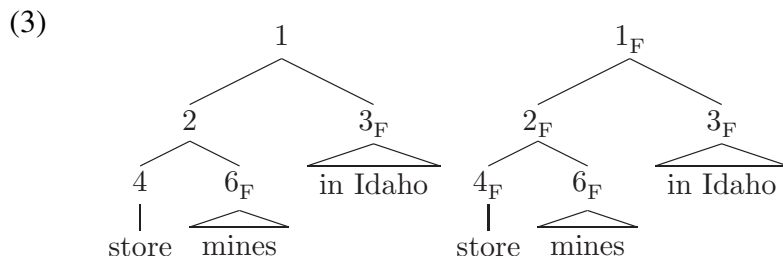
Katz and Selkirk (2011) looked at differential realizations of focus that is associated with a focusing adverb such as *only* or *mostly*, and F 's that merely mark novel constituents. Participants in the experiment read paragraphs that were constructed so that both complements in a VP modified by a focusing adverb were new in the context. One of the complements was construed as associated with the focusing adverb. (2) is an example. In (2a), the object *mines* is understood as associated, and *in Idaho* is merely new, while in (2b) *mines* is merely new, and *in Idaho* is understood as associated. The readings are truth-conditionally different.¹

- (2) a. ... for instance, they mostly store mines_{F-associated} in Idaho_{F-new}.
 b. ... for instance, they mostly store mines_{F-new} in Idaho_{F-associated}.

Katz and Selkirk found that phrases with projecting F were pronounced with more pitch movement and greater duration than phrases that were merely new. The differences were statistically significant, though small in absolute terms.

In the theory from Section 1, both complements in the examples of (2) must be F -marked, as shown in the tree on the left in (3), because none of the material is redundant. Really, all of the nodes are F -marked, as shown in the tree on the right. There is no way of expressing in this theory that one of the F 's projects to associate with *mostly*, while the other is the correlate of mere novelty. This is a problem on the assumption that correlations between semantics/pragmatics and phonetic realization must be mapped through the locus/scope/antecedent syntax.

¹Sample audio recordings of a couple of examples from the experiment are included in the data supplement Rooth (2015). The correspondence between prosody and truth conditions in these utterances strikes me as obvious.



More anecdotally, Roberts (1996/2012) felt that in “farmer sentences” like (4), the two tokens of *farmer* sound different, with the first one prosodically subordinate to *Canadian*, but not reduced. She conjectured that the adjective in [Canadian farmers] does not have alternative-focus at all. If it does have alternative-focus and the first token of *farmers* is grammatically novel and hence F-marked, then the representation is [Canadian_F farmers_F], leading to the same problem as in the Katz-Selkirk data.

(4) [Canadian_F farmers₃]₁ ~ 2 admire [American_F farmers ~ 3]₂ ~ 1.

Scott Hollis, formerly a DJ in the Ithaca area, used sentences like (5a) at the end of long sessions of music, with *saxophone* not sounding reduced and not being in the linguistic context. His Friday program was ended with utterances like (5b), with *Friday* not sounding reduced and not being in the linguistic context. One could say that Hollis intended for his listeners to accommodate a contrasting antecedent ‘today Friday’ or ‘speaker is seeing hearer today Friday’, accounting for the focus on *next*. But since *Friday* is not in the linguistic context, it is new. The problem is the same as before: in the syntax [next_F Friday_F], the projecting focus on *next* is not distinguished.

- (5) a. That was Phil Woods on the alto_F saxophone.
b. Hope to see you again next_F Friday.

For (5a), one can say that Hollis intended to acknowledge to his sophisticated audience that there also are other registers of saxophone, such as tenor. Since *saxophone* is not in the linguistic context, it is new. Then in the representation [alto_F saxophone_F] the F that triggers the alternative ‘P saxophone’ is not distinguished from the novelty F.

Sugahara (2003) looked in a production study at Japanese two-word nominals $\alpha\beta$, where alternative focus (F) on α was justified, and where preceding context was set up so that β was either new (N) or given (G). Japanese content words are either lexically accented (A) or lexically unaccented (U), and in the experimental materials, α and β were either both unaccented, or both accented. (6) is an approximate English rendering of one of the focus-over-new examples.

- (6) While it is Tokyo and Osaka that are known for crime, this week the manager of a [Yokohama_F [importing agency]] was arrested for selling marijuana to a model.

In both the AA and UU conditions, alternative focus followed by new was realized with a different pitch profile than alternative focus followed by given. For the accented condition, in the comparison (1AF)(2AN) vs. (1AF)(2AG), both words are accentual phrases, and (2AN) is realized with more pitch movement than (2AG). For the unaccented condition, in the comparison (1UF)(2UN) vs. (1UF)(2UG), the latter gets de-phrased to (1UF 2UG), with a single accentual phrase. The accentual phrase is the word-sized unit in Japanese phrasal phonology. These data are not problematic in the same way as the earlier data, because focus scoping over given is distinguished from focus scoping over new as in (7). But the different realization of focus over new and focus over given tends to support the representational assumptions of Section 1. And for focus over new, there is the problem of distinguishing the projecting focus.

- (7) Focus over given: $[[\alpha_F [\beta \sim k]] \sim j]$
 Focus over new: $[[\alpha_F \beta_F] \sim j]$

Comparative main clauses with anticipatory focus are a common examples of focus scoping over new. (8) has a focused main clause subject that takes scope at the main clause. The antecedent is standardly assumed to be the *than*-clause (Rooth 1992). The main clause verb phrase $[_{VP}\text{dance the tango}]$ in this example is not reduced. This contrasts with (9), where there is a preceding antecedent for the main clause VP, and the VP is reduced, or can be.

- (8) I should do the next part.
 Why? $[I_F [_{VP}\text{dance the tango}]_F] \sim 2$ better than $[you (\text{dance the tango})]_2$
- (9) I'm an expert at $[\text{dancing tango}]_1$.
 Hah! I bet $[I_F [_{VP} \text{dance the tango}] \sim 1] \sim 2$ better than $[you (\text{dance the tango})]_2!$

Representationally, the reduced main contrast VP in (9) is analyzed as $VP \sim 1$, where VP does not embed an F. By contrast, the unreduced main clause VP in (8) bears F, and the main clause with its focused subject is an instance of focus scoping over new.

Representations like these come up in the analysis of the disambiguation by focus of stripping ellipsis. (10a) is ambiguous between readings where the main clause subject or the main clause object are the correlate for the ellipsis remnant *you*. The readings are disambiguated by focus in the main clause, see (10b) and (10c). This is explained by the presuppositional focus constraints, on the hypothesis that the *than*-clause is the antecedent for focus in the main clause (Rooth 1992). When the main clause material outside the focused phrase is not in the discourse context, such examples are instances of focus scoping over new. For instance, in (10b), the main clause VP is new and the focus on the main clause subject scopes over it.

- (10) a. She beats me more often than you. (More often than you beat me/more often than she beats you).
 b. [she_F beats me] more often than you. (= more often than you beat me)
 c. [she beats me_F] more often than you. (= more often than she beats you)

3. A new framework for focus syntax and alternative semantics

How does F project “automatically” in the architecture from Section 1? This is a matter of the semantic interpretation of trees annotated with F and $\sim k$. A standard approach to this involves defining alternative sets recursively (Hamblin 1973, Rooth 1985). The base is provided by the axiom that the alternative set for a non-focused terminal is the unit set of the ordinary semantics of that phrase. So for instance the alternative set for the non-focused DP *John* is $\{\mathbf{j}\}$, the unit set of the individual \mathbf{j} . Second, the alternative set for a focused phrase is the set of all semantic objects matching the interpretation of the phrase in type. So the alternative set for the focused DP [John]_F is the set of all individuals in the model. The alternative set for $[\alpha \sim k]$ is also the unit set of the ordinary semantics of α , so that the redundancy operator makes any F’s embedded in its argument semantically invisible.

Alternatives propagate up the tree via a construction that defines the alternative set for a complex phrase in terms of the alternative sets for its parts. This recursive rule is stated in (11) for binary-branching nodes. We are given a binary-branching phrase of the form $[\alpha\beta]$, where the alternative sets for α and β are already defined. In the ordinary semantics, the semantic interpretation for $\alpha\beta$ is the result of applying some specific semantic operation to the interpretations of α and β . Say that rule is the rightward function-application operator r , so that $\llbracket \alpha\beta \rrbracket^o = r(\llbracket \alpha \rrbracket^o, \llbracket \beta \rrbracket^o)$, where $\llbracket \cdot \rrbracket^o$ indicates the “ordinary” semantic value. The same operation is used to propagate alternatives by defining the alternative set for the complex phrase to be the set of all values that can be formed as $r(a, b)$, where a is an element of the alternative set for α , and b is an element of the alternative set for β . This recursive rule provides for variation in the focused positions, and constancy elsewhere, because alternative sets for non-focused phrases are launched as unit sets.

$$(11) \quad \llbracket [\alpha\beta] \rrbracket^f = \{h(a, b) \mid a \in \llbracket \alpha \rrbracket^f \wedge b \in \llbracket \beta \rrbracket^f\}$$

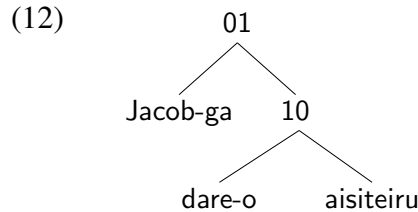
As a result of this architecture, a phrase that embeds an F that has not been terminated by $\sim k$ will have alternatives launched from that focus, and these alternatives will be semantically transformed and propagated upward by the recursive definition. This definition propagates alternatives blindly, independent of any morphosyntactic features. In this system, alternatives are terminated only by $\sim k$. So in a configuration $[\alpha_F \beta_F]$ (for instance $[\text{next}_F \text{Friday}_F]$), both F’s launch alternatives that propagate.

Essentially, the standard system was designed with the assumption that alternatives launched from any F were supposed to propagate until they are interpreted by $\sim k$. This was enabled by the tacit assumption that anything in the scope of an F that is outside the F is destressed. Empirically, the tacit assumption is refuted by the examples and experimental results reviewed in Section 2. At the theoretical level, the system is broken by the

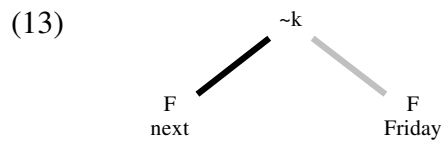
hypothesis from Schwarzschild (1999) that the novel/given distinction is part of the same grammatical system as “alternative focus”. When the representations that this entails are examined for data with focus scoping over new, the recursive definition of alternative sets breaks down.

The problem indicates that alternatives should *not* propagate automatically. This was anticipated in Dong (2009), Rooth (2009) and Rooth and Dong (2011), where information-structural operators are defined that regulate the propagation of alternatives. The motivation in these works was independent, having to do with second-occurrence focus and the phonology interface for focus.

(12) is a representation of a Japanese sentence from Rooth and Dong. Propagation of focus is regulated by information-structural operators 1 and 0, where 1 marks propagation of alternatives, and 0 marks non-propagation. The sentence here is a question *John who loves*, where the wh-phrase is in situ. In-situ wh phrases in Japanese, Korean and Chinese are argued to be grammatically focused (Beck 2006, Dong 2009). In the framework from Rooth and Dong, in order to generate a question with Hamblin semantics at the clausal level, there must be a “spine” of 1’s leading from the in-situ wh-phrase *dare* to the root node.



This representational move should help with the problem from Section 2. In (13), both of the terminals are F-marked. The left branch is marked for projection with 1, as indicated here with a dark edge, while the right branch is marked for non-projection with 0, as indicated with a gray edge. Semantically, this should correspond to an alternative set that contains ‘today Friday’, but not ‘next Saturday’. *Friday* is F-marked because it is novel, but it does not launch alternatives that propagate up. So in the antecedent *k*, there is no variation in the position of *Friday*.



The idea for interpreting these structures is that when a branch is marked for projection with 1, elements are selected from the focus semantic value of the corresponding child when the alternative set for the parent is composed. But when a branch is marked for non-projection with 0, the ordinary semantic value of the child is plugged in. (14) is a semantic rule along these lines, similar to the rule given in Rooth and Dong (2011). The first line defines the focus semantic value of a node of the form $[_{10}\alpha\beta]$. In the term $h(a, \llbracket\beta\rrbracket^0)$, *a* is

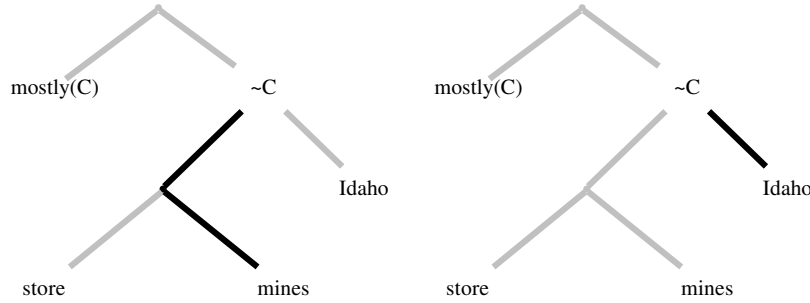
an alternative selected from $\llbracket \alpha \rrbracket^f$, while in the second position, the ordinary semantic value $\llbracket \beta \rrbracket^o$ is used. This blocks propagation of alternatives from the right child β .

- (14) Consider a node $[\pi\sigma\alpha\beta]$ where π and σ are drawn from $\{0, 1\}$. Let h be the ordinary semantic operation for the node. Then focus semantic values are defined as follows.

$$\begin{aligned}\llbracket [_{10}\alpha\beta] \rrbracket^f &= \{h(a, \llbracket \beta \rrbracket^o) \mid a \in \llbracket \alpha \rrbracket^f\} \\ \llbracket [_{01}\alpha\beta] \rrbracket^f &= \{h(\llbracket \alpha \rrbracket^o, b) \mid b \in \llbracket \beta \rrbracket^f\} \\ \llbracket [_{11}\alpha\beta] \rrbracket^f &= \{h(a, b) \mid a \in \llbracket \alpha \rrbracket^f \wedge b \in \llbracket \beta \rrbracket^f\} \\ \llbracket [_{00}\alpha\beta] \rrbracket^f &= \{h(\llbracket \alpha \rrbracket^o, \llbracket \beta \rrbracket^o)\}\end{aligned}$$

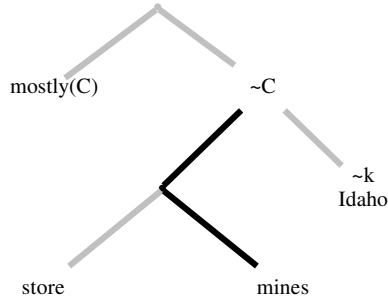
I will proceed a little differently, in order to optimize the treatment of how alternatives are launched at the base of projection paths, and to account for projection of alternatives being terminated by $\sim k$. (15) shows the projection paths in the Katz and Selkirk examples, with F's on the terminals left out. The idea is that the tree on the left indicates that alternatives are launched from the object *mines*, because there is a projection path going upward from that node. In the tree on the right, there is no projection path going upward from *mines*, and so no alternatives are launched upward from the object. This makes it unnecessary to include F's in the syntax. In the trees, to simplify the derivations below, the preposition in the PP [in Idaho] is omitted.

- (15) Projection paths in Katz and Selkirk examples



(16) is a version of the example on the left in (15) where *Idaho* is anaphorically distressed. It differs just in the inclusion of a redundancy operator on *Idaho*. Looking at (15) and (16), the new syntax can be decoded as follows. A node with a *projecting focus* is a node at the bottom of a projection path. A node that is a pure case of anaphoric distressing is labeled $\sim k$, without a projection path below it. A node not on a projection path that is not marked with $\sim k$ is a novelty F.

(16)



Now we are ready to look at a strategy for the recursive semantics of alternatives in the new system. (17) is a semantic derivation for the tree on the left in (15), indicating ordinary semantic values $\llbracket \cdot \rrbracket^o$, focus semantic values $\llbracket \cdot \rrbracket^f$, and an auxiliary alternative set $\llbracket \cdot \rrbracket^a$ that is used in defining projection of alternatives. $\llbracket \cdot \rrbracket^f$ is the focus alternative set that is defined using projection features, and which is used in the semantics of $\sim k$. The auxiliary alternative set $\llbracket \alpha \rrbracket^a$ for a node α is the set of alternatives which is passed upwards, provided that the edge above α is marked for projection.

(17)

	store	mines	$[_{01} \text{ store mines}]$
$\llbracket \cdot \rrbracket^o$	$\lambda y \lambda z \lambda x. \text{store}(x, y, z)$	m	$\lambda z \lambda x. \text{store}(x, \mathbf{m}, z)$
$\llbracket \cdot \rrbracket^f$	u	u	$\{\lambda z \lambda x. \text{store}(x, y, z) \mid y \in D\}$
$\llbracket \cdot \rrbracket^a$	D_{eeet}	D_e	$\{\lambda z \lambda x. \text{store}(x, y, z) \mid y \in D\}$
	$[_{01} \text{ store mines}]$	Idaho	$[_{10} [_{01} \text{ store mines}] \text{Idaho}]_{\sim k}$
$\llbracket \cdot \rrbracket^o$	$\lambda z \lambda x. \text{store}(x, \mathbf{m}, z)$	i	$\lambda z \lambda x. \text{store}(x, \mathbf{m}, \mathbf{i})$
$\llbracket \cdot \rrbracket^f$	$\{\lambda z \lambda x. \text{store}(x, y, z) \mid y \in D\}$	u	$\{\lambda x. \text{store}(x, y, \mathbf{i}) \mid y \in D\}$
$\llbracket \cdot \rrbracket^a$	$\{\lambda z \lambda x. \text{store}(x, y, z) \mid y \in D\}$	D_e	D_{et}

The VP syntax $[_{10} [_{01} \text{ store mines}] \text{Idaho}]_{\sim k}$ is the syntactic encoding of focus on *mines* projecting above new phrases *store* and *Idaho*. The primitive focus semantic value for the terminals *store*, *mines*, and *Idaho* is undefined. If the edge above *store* was marked for projection, that would be an edge that launched an alternative set. Accordingly $\llbracket \text{store} \rrbracket^a$ is D_{eeet} , the set of denotations matching $\llbracket \text{store} \rrbracket^o$ in type.² Similarly if the edge above *mines* were marked for projection (as it in fact is), that edge would launch alternatives. This correlates with $\llbracket \text{mines} \rrbracket^a$ being D_e , the set of individuals in the model.³ The same holds for *Idaho*, where $\llbracket \text{Idaho} \rrbracket^a$ is D_e .

The focus semantic value for $[_{01} \text{ store mines}]$ is $\{\lambda z \lambda x. \text{store}(x, y, z) \mid y \in D_e\}$, with variation in the position of *mines*. It is obtained as $\{r(\llbracket \text{store} \rrbracket^o, b) \mid b \in \llbracket \text{mines} \rrbracket^a\}$. This is like the second line in definition (14), except that $\llbracket \text{mines} \rrbracket^a$ is used in place of $\llbracket \text{mines} \rrbracket^f$, in order to launch alternatives. The focus semantic value for $[_{10} [_{01} \text{ store mines}] \text{Idaho}]_{\sim k}$ is

²This skirts the issue of intensionality. Alternatives have to encode intensional information, even though the local type of *store* is *eeet*. The technical development in Chapter 2 of Rooth (1985) takes this into account.

³To simplify the derivation, I am assuming that the compositional semantics of *store mines* amounts to filling an individual argument position.

$\{\lambda x.\text{store}(x, y, \mathbf{i}) | y \in D\}$, the set of VP denotations of the form ‘store y in Idaho’. It is obtained as $\{r(a, \llbracket \text{Idaho} \rrbracket^o) | a \in \llbracket [_{01} \text{store mines}] \rrbracket^a\}$. This is like the first line in (14), with $\llbracket \cdot \rrbracket^a$ used in the place of $\llbracket \cdot \rrbracket^f$. This time however, $\llbracket [_{01} \text{store mines}] \rrbracket^a$ and $\llbracket [_{01} \text{store mines}] \rrbracket^f$ are the same. The focus alternative set and auxiliary alternative set differ only when alternatives are launched or terminated.

(18) is a derivation for the tree on the right in (15), with projecting focus on *Idaho*. The final focus semantic value is $\{\lambda x.\text{store}(x, \mathbf{m}, z) | z \in D\}$, the set of VP meanings of the form ‘store mines in z ’. It is obtained as $\{r(\llbracket [_{00} \text{store mines}] \rrbracket^o, b) | b \in \llbracket \text{Idaho} \rrbracket^a\}$, with the ordinary semantic value used as the left argument of r , and elements of $\llbracket \text{Idaho} \rrbracket^a$ used as the right argument. $\llbracket \text{Idaho} \rrbracket^a$ is D_e , the set of individuals.

(18)	store	mines	$[_{00} \text{store mines}]$
$\llbracket \cdot \rrbracket^o$	$\lambda y \lambda z \lambda x. \text{store}(x, y, z)$	\mathbf{m}	$\lambda z \lambda x. \text{store}(x, \mathbf{m}, z)$
$\llbracket \cdot \rrbracket^f$	u	u	u
$\llbracket \cdot \rrbracket^a$	D_{eet}	D_e	D_{eet}
	$[_{00} \text{store mines}]$	Idaho	$[_{01} [_{00} \text{store mines}] \text{Idaho}]_{\sim k}$
$\llbracket \cdot \rrbracket^o$	$\lambda z \lambda x. \text{store}(x, \mathbf{m}, z)$	\mathbf{i}	$\lambda z \lambda x. \text{store}(x, \mathbf{m}, \mathbf{i})$
$\llbracket \cdot \rrbracket^f$	u	u	$\{\lambda x. \text{store}(x, \mathbf{m}, z) z \in D\}$
$\llbracket \cdot \rrbracket^a$	D_{eet}	D_e	D_{et}

Notice that in the left branch $[_{00} \text{store mines}]$, the focus semantic values are all undefined (written u). This is because there is no projection marking, so alternatives are never launched. Auxiliary alternative sets are formally defined, such as D_e for *mines*. These are however not used in the left branch in this tree.

In both (17) and (18), top VP is marked with $\sim k$. The semantics of this redundancy operator uses the local focus semantic value, and there is no change relative to Section 1 in the presupposition that is introduced. Analyzing the tree on the left in (15) in alternative semantics, the domain of quantification for *mostly* is constrained to be a set of properties of the form ‘store y in Idaho’. This achieves the design goal of making the semantic analysis of association with focus in focus-over-new examples be the same as otherwise. The projection mechanism has made the novelty F’s below $\sim C$ semantically invisible.

While the focus semantic value $\llbracket [_{10} [_{01} \text{store mines}] \text{Idaho}]_{\sim k} \rrbracket^f$ that is used in the redundancy semantics is obtained compositionally using the focus projection path from *mines*, the auxiliary alternative set $\llbracket [_{10} [_{01} \text{store mines}] \text{Idaho}]_{\sim k} \rrbracket^a$ is D_{et} , the set of VP denotations. This reflects the possibility of re-launching alternatives, after they are terminated by $\sim k$. One might expect the alternative set for $[_{10} [_{01} \text{store mines}] \text{Idaho}]_{\sim k}$ to be undefined as viewed from above, because $\sim k$ is supposed to make embedded focus semantically invisible. The disparity is explained by the interpretation of $\llbracket \alpha \rrbracket^a$ as the alternative set that is projected upward if the upward edge is marked for projection. Just as for a terminal, such projection launches alternatives when the child is marked with $\sim k$.

Re-launching comes up in examples with complex patterns of split focus antecedency. Schwarzschild (1999) pointed out that (19) should not be analyzed with a focus on *my* that projects all the way up, because this would indicate alternatives of the form ‘ y ’s mother

danced with John's mother'. These are not congruent with the alternatives contributed by the question.⁴ Instead the focus within [my_F mother] is motivated by contrast with *John's mother*, and there is an independent projecting focus on the phrase [my mother]. This pattern of focus and antecedency is represented in (20). With this syntax, $\llbracket [\text{my mother}] \rrbracket^f$ has alternatives launched from *my* that are used in determining the presupposition of ~ 3 . $\llbracket [\text{my mother}] \rrbracket^a$ has re-launched alternatives that contribute to the presupposition of ~ 1 .

- (19) Who danced with John's mother?
 My_F mother did.

- (20) [who [danced with [John's mother₄]₃]₂]₁
 $[\text{my mother}_{\sim 4}]_{\sim 3} \text{ did}_{\sim 2}]_{\sim 1}$

4. Theory of focus

This section gives a compact statement of the new syntax of focus and alternative semantics for focus, and also looks a bit at phonology. The syntactic part (21) constrains the syntax by requiring that there is a $\sim k$ at the top of each projection path. Otherwise it is hypothesized that projection features and $\sim k$ are assigned randomly in the syntax, and independently interpreted by semantics and by phonology.

- (21) Syntax of projection features and $\sim k$.
 All non-terminal nodes have branches marked with projection features drawn from 0, 1. Any node that has a downward branch marked with 1 either is marked with $\sim k$ or has its upward branch marked with 1.

(22) and (23) give the mutually recursive definition of focus alternative sets and auxiliary alternative sets. (22) is the same in its effects as the earlier modified Hamblin rule (14), except that $\llbracket [\alpha \beta] \rrbracket^f$ is undefined rather than being a unit set. Alternatives are projected only for branches marked with 1, while for branches marked with 0 the ordinary semantic value is plugged in. Auxiliary alternative sets have the role of both projecting alternatives recursively, and launching alternative sets. The latter is triggered by the local node being marked with $\sim k$, so that a new alternative set should be launched, and by the focus semantic value being undefined, which is true of terminals and other phrases which do not have an projection path below them. For both cases, the launching of alternatives is potential, in that the auxiliary alternative set is used in the next step above only if the branch is marked for projection.

⁴Or in entailment semantics, a representation with a single deep F would require that the proposition 'some person danced with John's mother' entail the proposition 'some entity's mother danced with John's mother'. It doesn't, because not every person is the mother of an entity.

- (22) Focus alternative sets for a node γ .
- a. If γ is a terminal node, then $\llbracket \gamma \rrbracket^f$ is undefined.
 - b. If γ is a binary branching node of the form $[_{00} \alpha \beta]$, then $\llbracket \gamma \rrbracket^f$ is undefined.
 - c. If γ is of the form $[_{\pi\sigma} \alpha \beta]$, where π and σ are not both 0, and h is the semantic operation for γ , then $\llbracket \gamma \rrbracket^f$ is the set of all values $h(a, b)$, where $a \in \llbracket \alpha \rrbracket^a$ if π is 1 and $a = \llbracket \alpha \rrbracket^0$ if π is 0, and $b \in \llbracket \beta \rrbracket^a$ if σ is 1 and $b = \llbracket \beta \rrbracket^0$ if σ is 0.
- (23) Auxiliary alternative sets for a node γ .
- a. If γ bears $\sim k$ or if $\llbracket \gamma \rrbracket^f$ is undefined, then $\llbracket \gamma \rrbracket^a$ is the set of all semantic objects matching $\llbracket \gamma \rrbracket^0$ in type.
 - b. Otherwise $\llbracket \gamma \rrbracket^a = \llbracket \gamma \rrbracket^f$.

The semantics of $\gamma \sim k$ refers to $\llbracket \gamma \rrbracket^f$, and introduces a presupposition using either alternatives or generalized entailment. (24) is an alternatives version, with the constraint stated as a definedness presupposition referring to $g(k)$, which is the interpretation of the antecedent relative to an assignment function g . For this purpose an assignment function parameter is added outside the semantic value brackets.

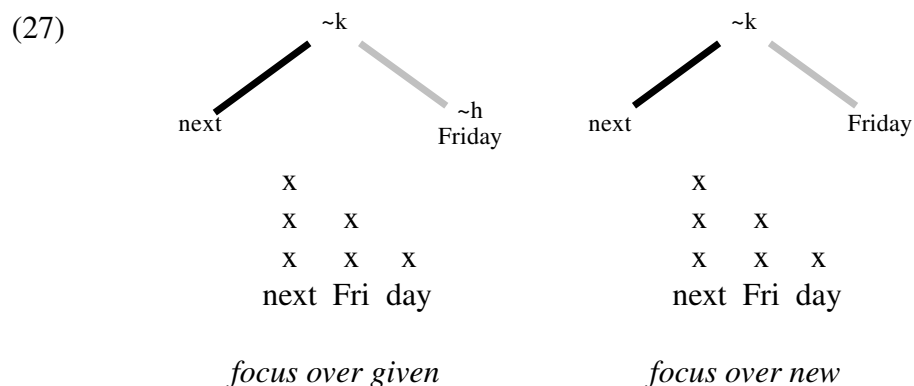
- (24) Presupposition of $\phi \sim k$ via alternatives.
- $\llbracket \phi \sim k \rrbracket^{0,g}$ is defined only if:
- a. $\llbracket \phi \sim k \rrbracket^{f,g}$ is defined and $g(k)$ is an element of $\llbracket \phi \sim k \rrbracket^{f,g}$ that is distinct from $\llbracket \phi \rrbracket^{0,g}$, or
 - b. $\llbracket \phi \sim k \rrbracket^{f,g}$ is defined and $g(k)$ is a subset of $\llbracket \gamma \rrbracket^{f,g}$ that includes $\llbracket \gamma \rrbracket^{0,g}$ and something else, or
 - c. $\llbracket \phi \sim k \rrbracket^{f,g}$ is undefined and $g(k) = \llbracket \gamma \rrbracket^{0,g}$.

I assume following Truckenbrodt (1995) that the immediate phonological correlate of focus should be a constraint Stress F stating that a focus is phonologically prominent in its scope. (25) is a statement of this in the old system. In the new system, this can be restated locally, along the lines of (26). Here a representation of stress prominence in a metrical grid is assumed, and reference is made to the distinguished terminal element (DTE) in a phonological unit. This is the most prominent element. The local statement of Stress F is an incremental improvement, because it is not necessary to refer to a complex correspondence between a focus, its scope, and the corresponding phonological domains.

- (25) Stress F
- Let β be an F-marked phrase with scope ϕ . Then the strongest stress in the phonological realization of ϕ falls within the realization of β .
- (26) Local Stress F
- Let nodes α and β be syntactic sisters, with the edge to α marked 1 and the edge to β marked 0. Then the grid height for the DTE of phonological realization of α exceeds the grid height for the DTE of the phonological realization of β .

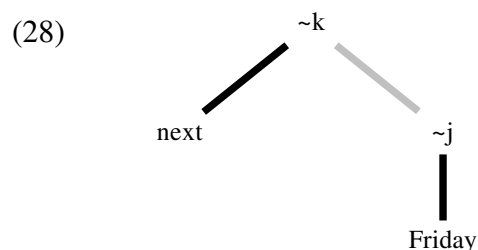
Rooth

However local Stress F is not sufficient to distinguish a simple token of focus scoping over given from a simple token of focus scoping over new. Section 2 said that the phrases in (27) were realized differently. But the metrical grids at the bottom satisfy local Stress F relative to their corresponding trees, and the grids are identical.



It looks like we need an additional constraint Phrase F that requires the DTE of any F phrase to head a phonological phrase at some minimal level, such as the accentual phrase in Japanese. With the additional assumption of a lower-ranked *Phrase providing pressure towards de-phrasing, this produces different phrasal realizations for the trees in (27).

There is a possibility for working Phrase F into Stress F, rather than having to state it as a separate interface constraint for focus. Suppose the syntax requires that any node is either on a projection path or marked with $\sim k$. This rules out the tree on the right in (27), and a novel use of *Friday* can not be represented with the tree on the left, because the antecedency constraint for $\sim h$ is not satisfied. This means that novelty F's must project a bit after all, as in (28). Formally, the novel *Friday* has an antecedent *j*. But if one works out the natural extension of the semantics (23)–(24) to unary branching, one finds that this antecedent is totally unconstrained, because the local focus semantic value for the node marked with $[\sim j]$ is D_e . This comes about because the $\llbracket \text{Jason} \rrbracket^a$ is D_e , and the branch above it is marked for projection. So novel phrases are ones which have trivially satisfied antecedency constraints.



In addition we need a version of Stress F which has the consequence that the phonological realization of a phrase at the top of a projection path is at some minimal level in the phonological phrasal hierarchy. This could be because the phrase at the top of the projec-

tion path needs to be strictly higher in the hierarchy than the phrase at the bottom, even for a non-branching configuration.

References

- Beck, Sigrid. 2006. Intervention effects follow from focus interpretation. *Natural Language Semantics* 1–56.
- Dong, Hongyuan. 2009. Issues in the semantics of Mandarin questions. Doctoral dissertation, Cornell.
- Hamblin, C.L. 1973. Questions in Montague English. *Foundations of Language* 41–53.
- Jackendoff, Ray. 1972. *Semantic Interpretation in Generative Grammar*. Cambridge, Massachusetts: MIT Press.
- Katz, Jonah, & Elisabeth Selkirk. 2011. Contrastive focus vs. discourse-new: Evidence from phonetic prominence in English. *Language* 87:771–816.
- Roberts, Craige. 2012. Information structure: Towards an integrated formal theory of pragmatics. *Semantics and Pragmatics* 5:511–545.
- Rooth, Mats. 1985. Association with focus. Doctoral dissertation, University of Massachusetts.
- Rooth, Mats. 1992. A theory of focus interpretation. *Natural Language Semantics* 1:75–116.
- Rooth, Mats. 2009. Second occurrence focus and relativized stress F. In *Information Structure: Theoretical, Typological, and Experimental Perspectives.*, ed. Malte Zimmermann & Caroline Fery. Oxford: Oxford University Press.
- Rooth, Mats. 2015. Replication data for: Representing focus scoping over new. DOI [dx.doi.org/10.7910/DVN/PNHJHF](https://doi.org/10.7910/DVN/PNHJHF), Harvard Dataverse Network.
- Rooth, Mats, & Hongyuan Dong. 2011. A recursive phonology interface for WH-F alternative semantics. In *SALT 21*.
- Schwarzschild, Roger. 1999. GIVENness, avoidF and other constraints on the placement of focus. *Natural Language Semantics* 7:141–177.
- Sugahara, Mariko. 2003. Downtrends and post-focus intonation in Tokyo Japanese. Doctoral dissertation, University of Massachusetts.
- Truckenbrodt, Hubert. 1995. Phonological phrases—their relation to syntax, focus, and prominence. Doctoral dissertation, MIT.